Health Literacy as a Social Determinant of Diabetes Outcomes: Implications for Equity and Population Health

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ABSTRACT

Background: Diabetes mellitus is a major global public health concern, driven not only by biological and behavioral factors but also by social determinants that shape individuals' capacity to prevent, manage, and live well with the disease. While advances in clinical care have improved diabetes treatment, persistent inequities in outcomes across socioeconomic, ethnic, and geographic groups indicate that biomedical approaches alone are insufficient. Health literacy has increasingly been recognized as a key social determinant of health, reflecting the skills and resources individuals need to access, understand, appraise, and use health information within complex health systems. In the context of diabetes, limited health literacy is highly prevalent and disproportionately affects socially disadvantaged populations, contributing to suboptimal glycemic control, increased complications, and avoidable healthcare utilization.

Aim: This review aims to examine health literacy as a social determinant of diabetes outcomes, with a focus on its role in shaping health inequities and influencing population health. The review adopts a public health and community medicine perspective, emphasizing structural, system-level, and policy-relevant implications rather than individual-level educational interventions.

Key Findings: Evidence from epidemiological studies and systematic reviews demonstrates that low health literacy is strongly associated with poorer diabetes outcomes, including inadequate glycemic control, lower adherence to treatment, reduced engagement in self-management behaviors, higher hospitalization rates, and increased mortality. Health literacy operates through multiple pathways, including impaired patient–provider communication, difficulties navigating healthcare systems, and limited ability to apply health information in daily life. Importantly, health literacy interacts with other social determinants such as education, income, language, and access to care, amplifying existing disparities in diabetes outcomes. Vulnerable groups, including older adults, ethnic minorities, migrants, and individuals with low socioeconomic status, bear a disproportionate burden of limited health literacy and its consequences.

Conclusion: Positioning health literacy as a social determinant of diabetes outcomes highlights the need for population-level and system-oriented responses. Strengthening health literacy requires not only improving individual skills but also creating health-literate environments through clear communication, responsive health systems, and inclusive public health policies. Integrating health literacy into diabetes prevention and control strategies has the potential to reduce inequities, improve population health outcomes, and enhance the effectiveness and sustainability of diabetes care worldwide.

Keywords: Health Literacy, Social Determinant, Diabetes Outcomes

INTRODUCTION

Diabetes mellitus is one of the most significant global public health challenges, characterized by rapidly increasing prevalence, substantial morbidity and mortality, and escalating healthcare costs. Despite advances in pharmacological therapies and evidence-based clinical guidelines, diabetes outcomes remain suboptimal in many populations, with marked disparities observed across socioeconomic, educational, and ethnic groups. These persistent gaps highlight the limitations of biomedical approaches alone and emphasize the need to address broader social determinants that shape disease outcomes [1].

Health literacy has gained increasing recognition as a critical social determinant influencing diabetes prevention, management, and long-term outcomes. Diabetes requires complex self-management behaviors, including medication adherence, dietary modification, physical activity, glucose monitoring, and ongoing interaction with healthcare systems. Inadequate health literacy can undermine patients' capacity to perform these tasks effectively, leading to poorer glycemic control, increased complications, and higher healthcare utilization [2].

From a population health perspective, health literacy operates not only as an individual-level skill but also as a socially patterned resource shaped by education, income, culture, language, and healthcare system complexity. Understanding health literacy as a determinant of diabetes outcomes is therefore essential for designing equitable, effective, and sustainable public health strategies [3].

Conceptualizing Health Literacy as a Social Determinant of Health

Health literacy has evolved from being viewed as an individual clinical risk factor to being recognized as a key social determinant of health embedded within broader social, economic, and structural contexts. Contemporary public health frameworks emphasize that health literacy reflects the interaction between individual capacities and the complexity of health information, healthcare systems, and social environments. Educational quality, socioeconomic position, cultural context, and language proficiency across the life course play central roles in shaping health literacy levels within populations [5].

As a social determinant, health literacy mediates the relationship between upstream factors such as education and income and downstream health outcomes. Individuals with lower educational attainment or socioeconomic disadvantage are more likely to have limited health literacy, which constrains their ability to access health services, interpret medical information, and engage in preventive and therapeutic behaviors. In diabetes, this mediation pathway contributes to persistent inequalities in disease awareness, treatment adherence, and metabolic control [6].

Health literacy also functions as a modifier of other social determinants by influencing how effectively individuals can utilize available healthcare resources. Even in settings where services are physically accessible, complex administrative processes, fragmented care pathways, and technical communication may disproportionately disadvantage individuals with limited health literacy. Consequently, health literacy shapes not only individual health behaviors but also the equity and effectiveness of healthcare delivery systems [7].

From a population health perspective, framing health literacy as a social determinant underscores the shared responsibility of individuals, healthcare organizations, and policymakers. Improving diabetes outcomes therefore requires not only enhancing individual skills but also reducing system-level complexity and creating health-literate organizations that support equitable access, understanding, and engagement across diverse populations [8].

Prevalence of Limited Health Literacy Among People With Diabetes

Limited health literacy is highly prevalent among adults living with diabetes and represents a widespread challenge across diverse healthcare settings. A comprehensive systematic review of patients with type 2 diabetes mellitus reported that the prevalence of limited health literacy ranged between 60% and 85%, indicating that the majority of individuals with diabetes experience difficulties in understanding and using health-related information essential for effective disease management [9].

This high prevalence is not uniformly distributed across populations. Older adults, individuals with lower educational attainment, and those of lower socioeconomic status consistently demonstrate higher rates of limited health literacy. These demographic groups also carry a disproportionate burden of diabetes prevalence and complications, suggesting that health literacy acts as a key mechanism linking social disadvantage to adverse diabetes outcomes [10].

Geographic and economic context further influence the distribution of health literacy among people with diabetes. Nearly 79%

of individuals with type 2 diabetes live in low- and middle-income countries, where health systems often face resource constraints and patient education infrastructures are limited. In these settings, limited health literacy is compounded by structural barriers such as overcrowded clinics, limited consultation time, and lack of culturally appropriate educational materials [11].

Even in high-income countries, limited health literacy remains common among patients with diabetes and is frequently underrecognized in clinical practice. Many individuals with adequate general literacy or formal education still struggle with diabetes-specific tasks, such as interpreting nutrition labels, understanding HbA1c values, or adjusting medications. This highlights that health literacy in diabetes is a context-specific construct that cannot be inferred solely from educational level [12].

Pathways Linking Health Literacy to Diabetes Outcomes

Health literacy influences diabetes outcomes through multiple interrelated behavioral, interpersonal, and system-level pathways. At the individual level, limited health literacy impairs patients' understanding of diabetes pathophysiology, treatment goals, and self-management requirements. Individuals with inadequate health literacy often struggle to interpret medication instructions, nutrition information, and blood glucose readings, which undermines their ability to make informed daily decisions essential for effective diabetes control [13].

Medication adherence represents a critical pathway through which health literacy affects diabetes outcomes. Patients with limited health literacy are more likely to misunderstand dosing instructions, timing of medications, and potential side effects, leading to unintentional nonadherence. Evidence demonstrates that lower health literacy is associated with poorer adherence to antidiabetic medications and reduced engagement in self-monitoring behaviors, contributing to suboptimal glycemic control [14].

Interpersonal communication between patients and healthcare providers is another key mechanism linking health literacy to diabetes outcomes. Individuals with limited health literacy are less likely to ask clarifying questions, participate in shared decision-making, or disclose difficulties with treatment regimens. This communication gap can result in misunderstandings regarding lifestyle recommendations, insulin titration, or follow-up care, ultimately compromising disease management and patient safety [15].

At the healthcare system level, complex care pathways and administrative processes disproportionately disadvantage individuals with limited health literacy. Navigating appointments, referrals, insurance requirements, and health records requires advanced literacy and problem-solving skills. Consequently, low health literacy is associated with delayed care, higher rates of emergency department utilization, avoidable hospitalizations, and increased healthcare costs among people with diabetes [16].

Health Literacy and Glycemic Control

Glycemic control is a central indicator of diabetes management and a key predictor of long-term microvascular and macrovascular complications. A substantial body of evidence demonstrates that limited health literacy is consistently associated with poorer glycemic control among adults with diabetes. Individuals with low health literacy tend to have higher HbA1c levels compared with those with adequate health literacy, even after adjusting for age, educational attainment, income, and comorbidities, indicating an independent relationship between health literacy and metabolic outcomes [17].

Early landmark studies highlighted the magnitude of this association by demonstrating that patients with inadequate or marginal health literacy were significantly more likely to have poor glycemic control than those with adequate literacy. These findings were among the first to suggest that health literacy functions as a determinant of clinical outcomes in diabetes rather than merely a correlate of sociodemographic factors, thereby strengthening the argument for its inclusion within social determinants frameworks [18].

Subsequent systematic reviews and meta-analyses have confirmed the robustness of the association between health literacy and glycemic control across diverse populations and healthcare settings. A meta-analysis examining the role of health literacy in diabetes found that inadequate health literacy was significantly associated with worse HbA1c outcomes, with effects mediated partly through self-management behaviors and medication adherence. These findings underscore the population-level relevance of health literacy for achieving glycemic targets [19].

The mechanisms linking health literacy to glycemic control are multifactorial. Limited understanding of medication regimens, difficulty interpreting blood glucose values, and challenges applying dietary recommendations contribute to sustained hyperglycemia over time. In addition, limited numeracy skills—a core component of health literacy—impair patients' ability to

adjust insulin doses, count carbohydrates, or recognize glycemic patterns, further compromising metabolic control [20].

Importantly, the relationship between health literacy and glycemic control has implications for health equity. Populations with higher prevalence of limited health literacy, including older adults, ethnic minorities, and individuals with low socioeconomic status, are also more likely to experience poor glycemic control and diabetes-related complications. This convergence reinforces the role of health literacy as a pathway through which social disadvantage is translated into unequal clinical outcomes [21].

Health Literacy, Diabetes Complications, and Healthcare Utilization

Limited health literacy has been consistently associated with an increased risk of diabetes-related complications, reflecting its influence on long-term disease management and timely access to care. Individuals with inadequate health literacy are more likely to experience poor control of glycemia, blood pressure, and lipid levels, which collectively accelerate the development of microvascular complications such as retinopathy, nephropathy, and neuropathy, as well as macrovascular outcomes including cardiovascular disease. These associations persist after adjustment for sociodemographic factors, underscoring health literacy as an independent determinant of complication risk [22].

Delayed recognition and response to early symptoms of diabetes-related complications represent a key mechanism underlying these outcomes. Patients with limited health literacy may have difficulty interpreting bodily cues, understanding the significance of early warning signs, or knowing when and how to seek medical attention. Consequently, complications are often identified at more advanced stages, when treatment is less effective and the risk of irreversible damage is higher. This pattern contributes to poorer prognoses and greater disability among individuals with low health literacy [23].

Healthcare utilization patterns among adults with diabetes further reflect the impact of limited health literacy. Numerous studies demonstrate that individuals with low health literacy are more likely to rely on emergency departments for diabetes-related care and to experience potentially avoidable hospitalizations. These utilization patterns are indicative of fragmented care, inadequate outpatient management, and failures in communication and follow-up, all of which are exacerbated by limited capacity to navigate healthcare systems [24].

Hospital readmissions represent another important dimension of healthcare utilization linked to health literacy. Patients with diabetes and limited health literacy are at increased risk of readmission due to misunderstandings of discharge instructions, medication changes, or follow-up plans. Poor comprehension at transitions of care can result in medication errors, missed appointments, and delayed management of complications, reinforcing cycles of acute care use and health system strain [25].

From a population health and health system perspective, the association between limited health literacy, complications, and healthcare utilization translates into substantial economic costs. Estimates suggest that low health literacy accounts for a significant proportion of avoidable healthcare expenditure, driven largely by preventable hospital admissions and emergency care. Addressing health literacy as a determinant of diabetes outcomes therefore offers an opportunity to improve system efficiency while simultaneously advancing equity and quality of care [26].

Health Literacy, Equity, and Vulnerable Populations

Health literacy is deeply intertwined with health equity because its distribution mirrors broader patterns of social advantage and disadvantage. Populations experiencing socioeconomic deprivation, lower educational attainment, and social marginalization are disproportionately affected by limited health literacy. In the context of diabetes, this unequal distribution contributes to systematic differences in disease prevention, management, and outcomes, reinforcing existing inequities across population groups [27].

Ethnic and racial minority populations with diabetes frequently experience compounded challenges related to health literacy. Language barriers, cultural differences in health beliefs, and limited availability of culturally appropriate health information can reduce understanding and engagement with diabetes care. Evidence indicates that limited health literacy partly explains observed disparities in medication adherence, glycemic control, and complication rates among minority populations, even within healthcare systems that offer nominally equal access to services [28].

Migrants and refugees with diabetes represent another particularly vulnerable group. Many face disrupted educational trajectories, unfamiliarity with host-country healthcare systems, and challenges related to language and trust. These factors contribute to lower health literacy and reduced utilization of preventive and continuity-of-care services. As a result, migrants

with diabetes are more likely to present late in the disease course and experience poorer outcomes, highlighting the need for health literacy–responsive and culturally sensitive public health approaches [29].

Older adults with diabetes are also at increased risk of limited health literacy due to age-related cognitive decline, sensory impairments, and increasing complexity of care related to multimorbidity. Limited digital literacy further exacerbates these challenges as healthcare systems increasingly rely on electronic health records, patient portals, and digital education tools. These barriers can reduce older adults' ability to access information and coordinate care, increasing the risk of medication errors and adverse outcomes [30].

From a community medicine perspective, addressing health literacy among vulnerable populations requires strategies that go beyond individual education. Structural interventions, including clear communication standards, interpreter services, culturally adapted materials, and community-based support, are essential for reducing inequities in diabetes outcomes. Framing health literacy as an equity issue underscores its relevance to social justice and the ethical delivery of diabetes care [31].

Measuring Health Literacy in Diabetes Populations

Accurate measurement of health literacy is essential for understanding its role as a social determinant of diabetes outcomes and for informing public health surveillance, research, and policy. Over the past two decades, multiple instruments have been developed to assess health literacy, each reflecting different conceptual approaches and dimensions. In diabetes populations, measurement tools must capture not only general literacy skills but also disease-specific competencies related to numeracy, self-management, and navigation of healthcare systems [32].

Early health literacy measurement tools focused primarily on functional skills, such as reading comprehension and numeracy, within healthcare contexts. Instruments such as the Test of Functional Health Literacy in Adults (TOFHLA) and the Rapid Estimate of Adult Literacy in Medicine (REALM) have been widely used in diabetes research. These tools have demonstrated strong associations between limited functional health literacy and poor diabetes outcomes; however, they have been criticized for narrowly defining health literacy and failing to capture interactive and critical dimensions relevant to chronic disease management [33].

In response to these limitations, multidimensional instruments have been developed to better reflect contemporary health literacy frameworks. Tools such as the Health Literacy Questionnaire (HLQ) and the European Health Literacy Survey Questionnaire (HLS-EU) assess a broader range of competencies, including the ability to engage with healthcare providers, navigate health systems, and appraise health information. These instruments are particularly relevant for diabetes populations, as they align more closely with the complex, ongoing demands of self-management and care coordination [34].

Despite advances in measurement, several challenges remain in assessing health literacy among people with diabetes. Health literacy is context-specific and may vary across healthcare settings, disease stages, and cultural environments. In addition, many instruments rely on self-report, which may be influenced by social desirability bias or limited insight. These challenges complicate comparisons across studies and populations and highlight the need for careful selection and interpretation of measurement tools in diabetes research [35].

From a public health perspective, incorporating health literacy measurement into population surveillance systems offers opportunities to identify high-risk groups, monitor trends over time, and evaluate the impact of policies and interventions. However, few countries currently include standardized health literacy indicators in routine diabetes surveillance. Strengthening measurement infrastructure is therefore a critical step toward recognizing health literacy as a core determinant of diabetes outcomes and integrating it into population health planning [36].

Health-Literate Health Systems and Population-Level Responses

Recognizing health literacy as a social determinant of diabetes outcomes necessitates a shift from solely patient-focused interventions toward system-level responsibility. The concept of health-literate health systems emphasizes that healthcare organizations play a central role in shaping how accessible, understandable, and usable health information and services are for diverse populations. In diabetes care, where long-term self-management and continuity of care are essential, system complexity can magnify the disadvantages faced by individuals with limited health literacy [37].

Health-literate health systems are characterized by clear communication practices, simplified care pathways, and organizational

policies that support patients in navigating services. Core attributes include the use of plain language, visual and non-written communication, confirmation of understanding through teach-back, and the integration of health literacy principles into leadership, quality improvement, and workforce training. Evidence suggests that when healthcare organizations adopt these attributes, patients with chronic diseases such as diabetes experience improved comprehension, safer care transitions, and greater engagement in ongoing management [38].

Primary care and community-based services represent critical settings for implementing health-literate system approaches in diabetes care. As the main point of contact for most individuals with diabetes, primary care systems that reduce administrative barriers, coordinate multidisciplinary care, and provide consistent, literacy-responsive communication can mitigate the negative effects of limited health literacy. Community-oriented primary care models further extend these benefits by linking clinical services with local resources and social support structures [39].

At the population level, integrating health literacy into national diabetes strategies and noncommunicable disease frameworks has the potential to improve equity and efficiency. Public health policies that promote clear communication standards, culturally appropriate education, and inclusive digital health design can reduce disparities in access and outcomes. International guidance increasingly recognizes health literacy as a strategic lever for strengthening health systems and improving population health, particularly in the context of chronic disease prevention and control [40].

Despite growing recognition, implementation of health-literate system principles remains uneven. Barriers include limited provider training, time constraints, competing organizational priorities, and insufficient policy incentives. Addressing these challenges requires coordinated action across sectors, including education, healthcare, and social services, as well as sustained political commitment to equity-oriented health system reform [41].

Public Health and Policy Implications for Diabetes Prevention and Control

Positioning health literacy as a social determinant of diabetes outcomes has important implications for public health practice and policy development. Traditional diabetes strategies have largely emphasized individual behavior change and clinical management, often overlooking the social and structural conditions that shape individuals' capacity to benefit from care. Integrating health literacy into public health frameworks allows policymakers to address upstream determinants of diabetes outcomes and to design interventions that are more equitable, sustainable, and population-oriented [42].

At the policy level, incorporating health literacy considerations into national diabetes prevention and control programs can strengthen their effectiveness and reach. Policies that mandate clear communication standards, support the development of culturally and linguistically appropriate materials, and promote patient-centered care models can reduce misunderstandings and improve engagement across diverse populations. Such approaches align with broader health equity goals and contribute to narrowing disparities in diabetes outcomes [43].

Workforce development represents another critical policy lever. Healthcare professionals often receive limited training in health literacy–responsive communication, despite its importance in chronic disease management. Integrating health literacy competencies into undergraduate, postgraduate, and continuing professional education can enhance providers' ability to communicate effectively with patients of varying literacy levels, thereby improving the quality and safety of diabetes care at scale [44].

Public health surveillance and monitoring systems also play a vital role in addressing health literacy as a determinant of diabetes outcomes. Incorporating health literacy indicators into routine data collection enables identification of high-risk groups, tracking of trends over time, and evaluation of policy impact. However, health literacy remains largely absent from diabetes surveillance in many countries, representing a missed opportunity to inform evidence-based planning and resource allocation [45].

Digital health policies warrant particular attention, as the increasing reliance on electronic health records, patient portals, telemedicine, and mobile health applications may inadvertently widen disparities for individuals with limited health or digital literacy. Public health policies that promote inclusive digital design, provide alternative non-digital communication channels, and support digital literacy initiatives are essential to ensure that technological innovation in diabetes care does not exacerbate existing inequities [46].

From a global perspective, international organizations have emphasized health literacy as a key enabler of noncommunicable disease prevention and control. Aligning national diabetes policies with global health literacy strategies can support progress

toward universal health coverage and the Sustainable Development Goals. Framing health literacy as a policy priority reinforces its role in strengthening health systems, improving population health, and advancing social justice in diabetes care [47].

Conclusion

Health literacy is a critical yet often overlooked social determinant of diabetes outcomes, shaping how individuals prevent, manage, and live with the disease within complex social and healthcare environments. The evidence synthesized in this review demonstrates that limited health literacy is highly prevalent among people with diabetes and is strongly associated with poorer glycemic control, higher rates of complications, increased healthcare utilization, and persistent inequities across socioeconomic and demographic groups. These patterns underscore that disparities in diabetes outcomes cannot be fully addressed through biomedical or behavior-focused strategies alone.

Conceptualizing health literacy as a social determinant highlights the interplay between individual capacities and structural factors such as education systems, healthcare organization, communication practices, and policy environments. Health literacy operates as both a mediator and amplifier of social disadvantage, translating upstream inequalities into unequal access to care, reduced effectiveness of treatment, and poorer long-term outcomes. This perspective shifts responsibility from individuals alone to health systems and societies, emphasizing the need for systemic change.

From a public health and community medicine standpoint, improving diabetes outcomes requires creating health-literate environments that support understanding, navigation, and engagement for all populations. This includes strengthening primary care and community-based services, reducing system complexity, enhancing provider communication skills, and embedding health literacy principles into national diabetes strategies and public health policies. Special attention must be given to vulnerable populations, including older adults, ethnic minorities, migrants, and individuals with low socioeconomic status, to ensure that interventions do not inadvertently widen existing disparities.

In conclusion, addressing health literacy as a social determinant of diabetes outcomes offers a powerful framework for advancing health equity and improving population health. By aligning individual support with system-level and policy-driven responses, health literacy–informed strategies can contribute to more effective, equitable, and sustainable approaches to diabetes prevention and control worldwide.

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